**Cross Cascades Corridor Analysis Project,**
**Notes from 1/19/01 Model Development Workshop**

***Workshop Goal*** – Understand the goals of the Cross Cascades Corridor model in enough detail to select a model approach and prepare a work program identifying those activities that would be necessary to build such a model.

***Workshop Accomplishments*** – In general, participants favored the Spatial Input/Output approach over four other traditional options for building corridor and statewide forecast models.

**Notes from the Workshop:**
The following notes are provided in the order in which they occurred during the workshop. They are also organized by the presentation slide, in order to provide context for remarks made by participants and presenters were responding to.

*Evolution of WSDOT Modeling/Corridor Planning*

> Todd Carlson noted that LTC policy questions drove initial funding for a statewide model development. When this funding was lost to budget cuts, I-90 corridor study funding was used to fund the Cross-Cascades project. Thus there are two objectives of the project: complete a corridor analysis for I-90; and develop a transferable/expandable model to respond to statewide LTC policy questions. The model should involve all current statewide planning/forecasting efforts, including MPOs and private companies (e.g., BNSF).
>
> Mark Charnews briefed the audience on the foundation of the PSRC model (i.e., it uses an Emme/2 framework for an enhanced 4-step model, etc.). The model is continually updated and an activity-based approach is under consideration. Tara Weidner reviewed the SRTC 4-step model using TModel2 based on a discussion she had with Ed Hayes of the SRTC.

In addition to the PSRC and SRTC models, other models in use in the corridor include: the Wenatchee Area Transportation Study using the TModel2 software (may need an update since the area will become an MPO in year 2002); the Moses Lake urban area uses TModel (needs update); and the Yakima area also uses TModel (which is planning an O-D survey/update). Dave Bushnell reviewed WSDOT's process for estimating future highway volumes and identifying deficiencies. This model employs a trend line analysis of existing PTR traffic counts and incorporates population growth differentials and peak period demands. A discussion ensued on the possible difficulties of a statewide model having to merge different MPO-specific assumptions and socio-economic (e.g., population, employment) forecasts.

> Doug Hunt and Tara Weidner reviewed other state's approaches to modeling, ranging from Oregon's Spatial I/0 based approach, the typical 4-Step approaches (used by over 25 states), and trend analysis approaches (similar to WSDOT Travel Delay Methodology). Shuming Yan stated that 'it would be nice to have a land use based model for the Cross Cascades Corridor model, although it may not be possible given the current scope and budget of this project. Faris Al-Memar noted the objective of making use of existing state/regional models, although this statewide model may eventually replace the current WSDOT travel delay methodology functions.

*Guiding Principles for Corridor Model Development*

Suggestion was made to edit bullet "Integrate output from other models" to "Integrated with other models", which was intended to reflect the need to develop outputs from the model that could enhance MPO models (e.g., external trips, freight).

When asked to rank the bullets in the slide in order of priority, the group began to analyze the principles and defined terms. Though there was no formal voting process and an acknowledgement that the list of principles may have grown into a longer list or simply a different list if the WSDOT project team had had more time to develop them, the project team generally agreed that the first four principles were "absolutely essential" while they were "more flexible" about meeting the criteria embodied in the bottom two principles.

*Why we model…*

After presentation of this slide, Doug Hunt led the participants through a group exercise where individuals were asked to list the "inputs" and "outputs" they would like to see incorporated into the Cross Cascades Corridor Model. These inputs and outputs were described in the context of "policy levers" and "measures", respectively. Each individual scripted their lists on blue and green post-it notes, with blue indicating an input and green indicating an output and placed them on the screen that projected the slide. During a break, consultant team members organized these inputs and outputs into general categories, as shown in the following pages.

*What are the Required Outputs*

In response to this slide, there was discussion about whether or not the model should be equipped to prepare output for peak hour or average daily traffic conditions. Faris mentioned that the WSDOT "Travel Delay Methodology is based on average daily volumes." Several participants mentioned that analyzing peak hour conditions is not really relevant for Cross Cascades corridor travel. That is, it's important in the MPO areas, but the MPO models already evaluate peak hour conditions. A suggestion was made that for the external trips into and out of the MPOs, the MPOs can use a temporal distribution factor to translate average daily traffic (ADT) into peak hour trips. The temporal distribution factor can be derived from WSDOT'S permanent traffic recorder (PTR) counts or other methods.

Rob Bernstein asked the WSDOT project team to try to describe the reasons that stakeholders are interested in having a Cross Cascades Corridor model. Faris explained that there are a variety of reasons generally involving a desire to have capability in the department to complete research and assessments of various policies and events. For example, in the Cross Cascades corridor, 1) Regional Administrators believe that

## Inputs or "Policy Levers"

| Category | Input |
|---|---|
| Interaction with MPOs | Integrate MPO models -- nodes, routes<br>Local/state coordination |
| Policy Guidelines or Specific Programs | Congestion relief<br>Energy conservation<br>BRCT Recommendations<br>Increased funding for alt. Choices<br>Multimodal decision-making |
| Road Pricing | Congestion pricing |
| Road Infrastructure and Connectivity | Freight mobility<br>New infrastructure<br>Changes in network configurations |
| Other mode Services | Increase AMTRAK service<br>Provide rail cars to shippers |
| Population and employment | Pop/employment growth<br>Port development<br>Growth management<br>Economic/tourism development<br>Impact of L.U. practices on mobility |
| ITS | Invest in ITS |
| Infrastructure maintenance | Current/future practices<br>Inclement weather et al<br>Economic/tourism development |

congestion is increasing in rural areas, especially due to weekend recreation travel, and they need a means to understand how bad it's getting; 2) some citizens would like to see a realignment or bypass along SR2, while others would like it to remain as it is; and 3) WSDOT management and staff would like to be able to explore whether improvements along SR 2 or along I-90 would improve overall corridor travel conditions (passenger and goods movement).

As information for consideration of analyzing weekend and special event travel conditions, several participants spoke of the weekend traffic congestion during winter ski season. Dave Bushnell mentioned that his analysis of PTRs indicates weekend travel on segments of I-90 and SR 2 is often 150% higher than weekday travel. The PTRs also provide good seasonal variation factors historically.

## Outputs

| Category | Output |
|---|---|
| Traffic Volumes (external, by mode/facility, growth, rush hour) | Freight volume changes<br>External-External; External/Internal<br>SOV rates<br>Train volumes<br>Truck VMT<br>VMT/capita<br>Peak hour |
| O-D Demand (by mode, trip purpose, and passenger/freight) | Passenger vs. Freight trips<br>Commodity flows<br>Vehicle mix on highways |
| System Performance (deficiencies, congestion, etc.) | Identify deficiencies<br>6 and 20-year forecasts<br>Corridor-wide performance measures<br>Track investment/outcome performance<br>Test proposed solutions |
| Feed other models (maintenance, safety, AQ, fuel consumption) | Roadway performance<br>Maintenance<br>Safety<br>Fuel consumption<br>AQ benefits/impacts |
| User and Public Costs | User costs<br>Public costs<br>Geog. Distribution of Econ. Benefits |
| Travel Delays/Travel Times (reduction, benefit) | Travel time benefits/impacts<br>Travel delay reduction |

*Potential Approaches – Long Term View*

The intent of this discussion was to identify the needs for the Cross Cascades Corridor Model framework, and in particular, the ability for the framework to not limit needs for future analyses (e.g., land use-transportation interactions) the department may want to use the model for. Five approaches[1] to building a Cross Cascades Corridor model that is "transferable" to other corridors, and is "expandable" for statewide modeling purposes and for higher levels of analysis were presented for discussion.

In addition to understanding the long-term analytical merits of one approach versus another, the group discussed the maintenance/update requirements of each approach. This reflected WSDOT's desire to be able to analyze basic policy questions with the model using in-house staff. While acknowledging that modeling travel forecasts is a process of continuous refinement and updating, the group viewed the requirements for updating the Spatial I/O method to be less of a day-to-day requirement than the other methods. However, the Spatial I/O model would require periodic updates and those

[1] The five approaches are; 1) 4-Step process; 2) Spatial Input/Output model; 3) Trip table approach; 4) Microsimulation; and 5) Linear Program model.

might require a significant amount of time and economic expertise to complete. Under this contract's scope, model development would be limited to assembly and borrowing of coefficients from other state models. Calibration/validation efforts would occur in follow-on efforts. Both the 4-Step and Spatial I/O approaches require the same data set for assembly, calibration and validation, except for the need for a State of Washington I/O table in the Spatial I/O method. It was felt that such an I/O table would be readily available from public/private sources.

Key WSDOT WTP outcomes, to be addressed by the model, cited by Faris and Todd, include congestion, freight movement, and economic prosperity. It was felt the Spatial I/O approach would be the only model able to directly address economic prosperity questions.

*Possible in Twelve Weeks (a series of five slides)*

Led by Doug Hunt, the advantages and disadvantages of each approach were defined and were presented in the context of the feasibility to complete the model development process in twelve weeks, which is what the consultant team has budgeted for completion of this phase of the project. While none of the approaches would result in a comprehensive model at the end of twelve weeks, some approaches would have greater success in producing a meaningful, albeit incomplete, model.

For example, the Microsimluation model approach was dropped from further consideration because of its complexity and the inability for the team to complete a meaningful model in the twelve-week period. The Linear Program model approach was dropped from further consideration because it would require an extensive data collection process and the approach does not have the ability to produce forecasts on its own.

The value of the Trip Table approach was discussed, with some participants focusing on its relative simplicity (no trip generation or distribution) and others concerned about the inability of the Trip Table method expand the model to other corridors, incorporate behavioral responses to congestion, and to provide comprehensive outputs.

A lengthy discussion ensued about the comparative merits of the 4-Step and Spatial I/O model approaches. Advantages associated with the 4-Step method include: it being the traditional method used throughout the state and in other states; its relative simplicity; and the fact that if work had to be halted at any time, that the 4-Step model would produce useful and consistent outputs.

**Comparing Spatial I/O and 4-Step Approaches**

The group clearly felt that a Spatial I/O model had enormous advantages over the 4-Step model in the long term because ultimately it would be a land-use based model allowing for state-of-the-art analyses of the interactions between land use decision making and actions and resulting transportation behavior. The fact that the Spatial I/O method is driven by economics was felt to be more appropriate than the other methods to answer certain statewide policy questions and would provide a more consistent economic modeling of goods movement. The dynamic nature of the model – where land use actions directly trigger transportation behaviors every three years – had wide appeal to the group. This land use trip generation elasticity (not available in initial 12-16 week development effort) was cited as a reason why the (inelastic) 4-Step methods have historically had difficulty modeling at the statewide level.

| 4-Step Model Advantages: | 4-Step Model Disadvantages: |
|---|---|
| • A familiar method used throughout the state and in other states.<br>• Relatively simple.<br>• Can produce useful outputs even when it is not completely finished.<br>• Only 15%-20% chance the development of this method will take longer than 12 weeks.<br>• Will be less of a challenge to recruit staff familiar with this type of model. | • Does not produce land-use feedback.<br>• Cannot be expanded into representations of economy.<br>• Does not have land use policy analysis capability.<br>• It is questionable whether this type of model is appropriate for this type of (statewide) analysis. |
| **Spatial I/O Model Advantages:**<br>• In the long term, would allow for state-of-the-art analyses of the interactions between land use decision-making and actions, and resulting transportation behavior.<br>• Would require less day-to-day updating.<br>• Addresses all outputs required.<br>• Vast opportunity for future expansion.<br>• Can make use of coefficients developed for Oregon.<br>• Output quality will improve with improved (real) data.<br>• Does not duplicate MPO models.<br>• Will provide economic forecasts. | **Spatial I/O Model Disadvantages:**<br>• 50% chance the development of this method will take longer than 12 weeks (up to 16 weeks).<br>• Operation of this model will require a more sophisticated staff (e.g., knowledgeable about economics).<br>• Periodic updates would require a significant amount of time to complete. |

Additionally, the Spatial I/O approach was felt to be more useful in MPO-State model integration, since it would differ from the MPO 4-Step framework. A major concern with the Spatial I/O model was that there would be a longer period of time that analysts would need to create the model structure and to test the model operations than there would be with the 4-Step process.

According to Doug Hunt, there was a 50% chance the team would not be able to produce a working population/employment based model using the Spatial I/O approach in twelve weeks, while there would be an 85% of producing an operational 4-Step model in twelve weeks. Doug Hunt asserted that in his experience, with 16 weeks, the consultant team could produce an operational Spatial I/O model based on population and employment that would be capable of being directly upgraded to a land use base once time and resources became available.

Comments to this discussion include:

§ Jin Ren, TRPC, advocates the Spatial I/O approach for several reasons. He explained that an important characteristic of the 4-Step method is that it produces impedances that are not relevant to the Cross Cascades Corridor. He felt the Spatial I/O approach

would be a more appropriate model for statewide modeling. He said that he's looking for information on productions and attractions in external zones that would allow him to refine the information the Olympia model already uses with outputs that are consistent with the relatively high level of statistical accuracy used in the Olympia model. Jin Ren would like to see the State develop a Spatial I/O model because in the future Olympia will be upgrading its model to a land use/transportation dynamic model.

- Shin Won Kim, RTC, stated that he thinks highly of the Spatial I/O model but he is concerned about the higher risks in developing that kind of model versus a 4-Step or even a Trip table model in a period of twelve weeks. Shin Won stated that unless the State is willing to undergo a 3 to 4 year development program, that he would favor the 4-Step approach. He believes that there are very few experts available to build a Spatial I/O model. Shin Won said that he would incorporate the external zonal information (especially tourism) and freight travel produced by the Cross Cascades Corridor model regardless of the model approach into the RTC model. He felt some of the 4-step model's shortfalls (e.g., land use impact) could be addressed through iterative model applications, post-processing of model output, or reorganization of the order of the 4-steps.
- Mark Charnews, PSRC, stated that it didn't matter to him whether the State developed a 4-Step or a Spatial I/O model because he's only interested in the external trip productions and attractions and either method would improve the accuracy the PSRC model has in understanding these trips. The difference between the output on external trips produced by either model is "negligible" and would represent nothing more than "noise in the PSRC model." Mark agreed that the features of the Spatial I/O approach could address more state-level policy questions, but due to the added risk, WSDOT needs to identify the real need for these features.
- Paula Reeves, WSDOT TDM, was encouraged to see the group considering a model that addresses all modes at a statewide level. She favored the Spatial I/O but felt that the 4-Step process could be improved by changing the order of the steps, as suggested by Shin Won.
- Dave Bushnell, WSDOT TDO, indicated he liked the Spatial I/O approach since he feels the 4-Step methods are pushed beyond their limit in statewide applications. He felt the Spatial I/O method would be better able to address the growth of fringe areas around the urban centers, not covered by the MPOs.

The WSDOT project team discussed whether or not the consultant team would have only twelve weeks to complete this task. Nancy Boyd asked the audience not to make determinations about adding time to the modeling effort at the expense of the later corridor plan development effort because a Chartering session has not been completed for that phase of the project yet. Nancy explained that it would premature to make assertions about how much time is needed for the corridor plan until that session is completed.

*Next Steps*

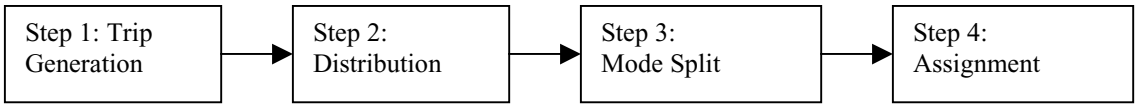
The meeting was running out of time and a decision was made not to continue with the prepared slides but to rather summarize the highlights and decisions made in the meeting and to describe the WSDOT project team and consultant team's next steps.

The teams will meet again on Tuesday 1/23/01 to explain the risks and advantages to developing a model in the Spatial I/O architecture. At that time, the team will develop a work program to be presented at the second technical workshop scheduled for 2/2/01.

In addition, the consultant team will review whether a portion of the time required to produce the corridor plan phase of the project can be done simultaneously with the model development phase; and if so, whether that would amount to the four weeks additional time that is felt to be necessary to produce an operational Spatial I/O model.

**Additional Notes on Spatial I-O Model versus 4-Step Method**

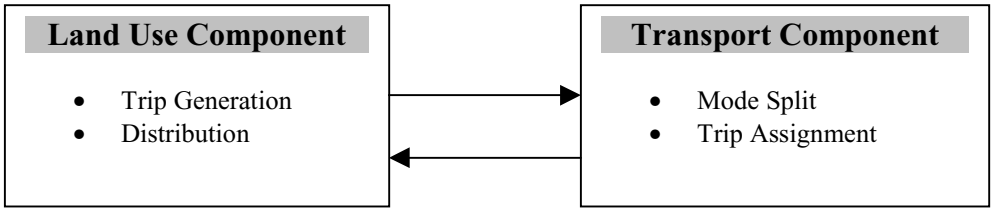
**Four Step:**




Advantages of this framework were that the steps could be worked on simultaneously. Further, even if the model were not up and running prior to the time the data were needed in the corridor analysis the completed steps and the O&D tables could inform the corridor planning process. Coefficients could be "borrowed" from other models to assemble the model, which could be calibrated later.

Disadvantages are that all forecasts must be outside the model – it is not dynamic. Also, it was acknowledged that without elastic trip generation, for which there is not enough time to develop, the model may not give reliable results.

**Spatial I-O**




The Spatial I-O model uses a land use component to generate and distribute trips and a transport component to generate mode split and trip assignments. The two sides of the model "inform" each other, resulting in a dynamic model. It was pointed out that the model can be constrained to predetermined population and economic forecasts if desired. The fact that the model uses an economic Input-Output table to generate traffic may avoid pitfalls of inelastic trip generation and limited commodity data for freight. As with the 4-step approach, it would be possible to substitute population and employment by zone for a true land use component and to "borrow coefficients" from other models for determining modes split and trip assignments.

A major drawback of this approach is that there are no interim results to inform the planning process if model development takes longer that expected. Also, it will be necessary to buy the MEPLAN model and to train someone in how to use it. (Unlike the 4-step approach with uses models with which many modelers are familiar.)

**O&D Tables**

It will be necessary to generate O&D tables to run either model. If the models are not fully functional by the time needed for the corridor plan these tables will be of great value anyway.

# Cross-Cascades Corridor Analysis Project
# Model Development Workshop #1,
# January 19,2001

Attendees:

| | | |
|---|---|---|
| 1. | Sorin Garber | HDR |
| 2. | Doug Hunt | HDR |
| 3. | Tara Weidner | HDR |
| 4. | Mark Ford | HDR |
| 5. | Jolyon Rivoir-Pruszinski | HDR |
| 6. | Rob Bernstein | TranSystems |
| 7. | Todd Carlson | TPO; part of meeting |
| 8. | Bill Osterhout | TPO; part of meeting |
| 9. | Katherine Klockenteger | TPO |
| 10. | Kirk Frederickson | WSDOT Rail Office; part of meeting |
| 11. | Ralph Wilhelmi | TPO; part of meeting |
| 12. | Nancy Boyd | TPO |
| 13. | Faris Al-Memar | TPO |
| 14. | Mark Charnews | PSRC |
| 15. | Shuming Yan | WSDOT Olympic Region; part of meeting |
| 16. | Jin Ren | TRPC |
| 17. | Shinwon Kim | RTC |
| 18. | Paula Reeves | WSDOT TDM Office |
| 19. | Dave Bushnell | WSDOT TDO |

# Cross-Cascades Corridor Analysis Project
# Model Development Workshop #1
# January 19, 2001

## AGENDA

| | | | |
|---|---|---|---|
| | Welcome | Nancy Boyd | 8:30 |
| I. | Goal for Today's Workshop | Nancy Boyd | 8:45 |
| II. | Evolution of WSDOT Modeling/Corridor Planning | Todd Carlson | 8:50 |
| III. | Guiding Principles for Corridor Model Development | Sorin Garber | 9:00 |
| IV. | Why we model? | Doug Hunt | 9:10 |
| V. | What are the Required Outputs | Doug Hunt | 9:25 |
| | Break | | 10:00 |
| VI. | Potential Approaches -- Long Term View | Doug Hunt | 10:15 |
| VII. | Possible in Twelve Weeks | Doug Hunt | 10:30 |
| VIII. | Possible in Twelve Weeks-Linear Program Model | Sorin Garber | 11:45 |
| | Lunch | | 12:00 |
| IX. | Further Scope Considerations | Doug Hunt | 12:30 |
| X. | Borrowing Data from other Models | Doug Hunt | 1:15 |
| XI. | What Data do we Want? | Doug Hunt | 1:45 |
| | Break | | 2:30 |
| XII. | Candidate Software Packages | Doug Hunt | 2:45 |
| XIII. | Developing the Work Plan | Sorin Garber | 3:30 |
| XIV. | Structure and Content of Work Plan | Sorin Garber | 4:00 |

Presentation Materials

# Cross Cascades Corridor Analysis

## Technical Workshop No. 1:

*Establishing a Work Plan for Model Development*

Cross Cascades Corridor Analysis --
Technical Workshop No. 1

# Welcome

- Personal Introductions
- Brief Summary of Overall Scope
- Why do we need a travel demand forecast model?

Cross Cascades Corridor Analysis --
Technical Workshop No. 1

## Goal for Today's Workshop

To identify the attributes, capabilities and ingredients for the Cross Cascades Corridor forecast model in enough detail to allow the consultant team to define a work plan for completion of the model. This work program would be presented at the second Workshop.

Cross Cascades Corridor Analysis --
Technical Workshop No. 1

## Evolution of WSDOT Modeling/Corridor Planning

- WSDOT Practices – How its done
- Description of PSRC, SRTC and other models in the corridor
- Other states' approaches to statewide modeling

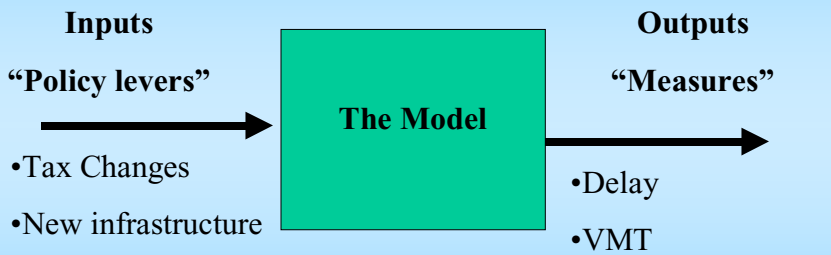
Cross Cascades Corridor Analysis --
Technical Workshop No. 1

# Guiding Principles for Corridor Model Development

- Produce interregional forecasts and analyses
- Integrate output from other models
- Transferable and expandable
- Provide 6-year and 20-year forecasts
- Consider alternative modes of travel
- Be "visually" and "user" friendly

Cross Cascades Corridor Analysis --
Technical Workshop No. 1

# Why we model….




Cross Cascades Corridor Analysis --
Technical Workshop No. 1

## What are the Required Outputs

- AADT volumes by vehicle type
- O-D Matrix by trip purpose
- Mode share
- Travel time/speeds
- GIS displays of data/findings

Cross Cascades Corridor Analysis --
Technical Workshop No. 1

## Potential Approaches -- Long Term View

- 4 Steps (emme/2, TransCAD) assembled vs. calibrated
- Spatial I/O (MEPLAN and further)
- Trip tables (Entropy maximization)
- Microsimulation (VISSIM, ad hoc)
- Linear Program (Snake River)

-- want to "expand" to this…
-- evaluate against "guiding principles"

Cross Cascades Corridor Analysis --
Technical Workshop No. 1

# Possible in Twelve Weeks

4 steps

- Assembled, NOT calibrated
- Intercity model
- Population/employment demand driven
- Use MPO models as key exit/entry points
- Sequential 4-step process
- Borrow data from other statewide models
- 24-hour with factoring to get peaks
- Limit detail with respect to commodity flows
- May not have feedback to non-assignment steps

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# Possible in Twelve Weeks

Spatial I/O

- Assembled, NOT calibrated
- Intercity model
- Population/employment endogenous
- Use MPO models as key exit/entry points
- Need State I/O data
- Borrow data from other statewide models
- 24-hour with factoring to get peaks
- Limit detail with respect to commodity flows
- Greater need for completeness (greater risks)

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Technical Workshop No. 1

# Possible in Twelve Weeks

## Trip Tables

- Data driven and estimated
- Network model
- Population/employment exogenous
- Borrow data from other statewide models for mode split
- 24-hour with factoring to get peaks
- Based on count data: truck movements rather than commodity flows
- Frataring to grow matrices
- Greater need for completeness (least risk)

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# Possible in Twelve Weeks

## Microsimulation

•Not possible in twelve weeks.

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# Possible in Twelve Weeks

Linear Program Model

- Extensive data needs–requires additional O-D data
- Less transferable
- Forecasts are external to the model
- Intermodal capacities – no network assignment
- Not an integrated package

Cross Cascades Corridor Analysis --
Technical Workshop No. 1

# Further Scope Considerations

- State highways, RR and air routes
- Geographic area of influence – external and internal trips
- Appropriate zonal structure
- Issues – avalanches, weight restrictions, tunnel clearances, others?

Cross Cascades Corridor Analysis --
Technical Workshop No. 1

## Borrowing Data from other Models

- PSRC and SRTC model data
- Other models in the corridor
- Model co-efficients from other states
- External trip O-D
  - Commodity Flow Survey
  - Nat'l Personal Transportation Survey

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Technical Workshop No. 1

## What Data do we Want?

- Socio-economic – existing and future
- I/O table
- Freight O-D network – intrastate, interstate, international, intermodal
- Passenger O-D network
- Existing passenger/freight counts by mode
- Network and service characteristics
- GIS databases

Cross Cascades Corridor Analysis --
Technical Workshop No. 1

# Candidate Software Packages

**Issues**

- Off-the-shelf
- Learning curve
- Statewide applicability
- Purchase cost
- Future flexibility
- Support
- GIS integration

Cross Cascades Corridor Analysis --
Technical Workshop No. 1

# Developing the Work Plan

- What are the contents?
- What is the TAC's role?
- The Peer Review Panel

Cross Cascades Corridor Analysis --
Technical Workshop No. 1